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## **Trade and the Automobile Sector**

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## **Abstract**

The present work aims to study the tendency experienced in the global automobile sector and what is its current situation. To begin with, a review of the existing literature is explained and after that, the current characteristics of the sector are described. Among the different topics that are investigated in this paper, there will also be an emphasis on the current business mergers and what their implications are for concentration indices. Furthermore, there will be a focus on how important trade policies have been for the current development of the sector, as well as on the most recent events. In addition to analyzing this industry worldwide, we will also comment on the Spanish situation and whether it differs from the world trend or, on the contrary, it converges. To sum up, an economic estimate has been made and in which the factors that influence passenger car registrations in Spain will be calculated through a time series from 2002 to 2020.

**Keywords:** Automobiles, Econometric Estimation, Trade, Market Structure

**JEL Codes:** L62, C2, F1, L1

## 1. Introduction

The opening to foreign trade consists of the exchange of goods or services between two or more countries. In particular, the automobile sector is one of the most open to the external world since it is highly delocalized and one of the industries that move money the most within the world economy. This is due to the complex system of production, research and sales that exist behind this sector.

The automobile industry is one of the most economically supported markets because it requires large amounts of money for production and constant investments in research and development (R & D). In fact, technology is currently progressing at an unimaginable speed and competition tends to be very high among these types of markets. Their products require constant improvements in order not to remain out-dated and, as a consequence, get dominated by the competition.

The level of competition is enormous as well as the production figures. Traditionally, production was usually found in developed countries, but nowadays we can see a clear tendency towards production in emerging countries for various reasons that will be argued in this paper. In addition, economic policies show, now more than ever, a notable difference from what has been experienced in the past, mainly due to free trade agreements between countries or regions, although not all of them act by following this way.

The main objective of this paper will be to analyse the structure of this market, where we will learn about its peculiarities and competitions. Furthermore, we will also stop to comment on the importance of this industry in our country and why it would be convenient to protect it with a perspective to the future together with the tendency that is gradually becoming frequent among companies: mergers or acquisitions.

Moreover, we will see how important trade policies are for the sector that has been selected and what role do the different countries play at a regional level, as well as for the future of the automotive economy. To conclude, we will study through an empirical-econometric analysis the number of passenger car registrations in Spain over a time series of the last 18 years according to several explanatory variables.

## 2. Literature Review

Given the importance of the automotive sector worldwide, there are numerous academic papers that analyze both the factors that influence within the sector and the effects that this industry has on the global economy. There are also multiple articles in which existing tendencies are studied with the purpose of trying to predict what may happen in the future of the automobile sector. Here below some of these academic papers have been presented with the aim of helping us contextualise and have an overview of the automotive sector.

Thanks to the work completed by David Haugh, Annabelle Mourougane and Olivier Chatal (2010), the reason for the decrease in car registrations in recent years has been studied as well as the projection that is expected for the future. The authors came to the conclusion that the sector is strongly linked to the state of the economy, acting procyclically with it. Overall and in addition to the situation of the economy, the collaboration of governments is decisive for the automotive sector by facilitating assistance for acquisition, together with a greater involvement of the financial markets that would promote the granting of credits. Regarding future expectations and based on an econometric study, the authors have determined that, in the medium term, mature markets are expected to stagnate, whereas economies such as China or India are supposed to experience a strong growth.

Nagy, Judit & Jám bor, Zsófia (2018) — through an econometric estimation — have reached several conclusions by analyzing the competitiveness of the automobile sector and the volume of exports. On the one hand, they have concluded that the countries that produce the most cars are China, the United States, Germany and Japan respectively. However, those that export the most are Germany and Japan. This means that the two largest powers in the world mainly produce for their own market. On the other hand, by using the Balassa index, it was obtained that Japan and Spain have the greatest comparative advantage in the world in all the periods that have been analyzed.

The researcher Michel Freyssenet (2010) analyzed the behavior of the automobile sector during the 2008 economic crisis and wanted to study what could happen in the not too distant future of this industry. After completing his work, Freyssenet (2010) came to a few conclusions. The most relevant one is that the automobile propelled by alternative

energies would generate a paradigm shift in the global industry, causing the so-called second automobile revolution. In addition, emerging countries would find in this type of vehicles the opportunity to enter the sector with greater force, since they require a quite different industrial structure which is very well-adapted to these countries.

Ana Colovic and Ulrike Mayrhofer (2011) wanted to study in their article whether automobile multinationals were diverting their production factories to other regions and, if so, to find out why. After the study, the authors found significant evidence that these companies are geographically diversifying their production plants, at least in one of the regions with the greatest weight in the production of automobiles in the United States. In addition, they found that the main destination is emerging countries, where these automobile multinationals can implement new technologies in R & D, take advantage of the geographical location provided by these countries and diversify their production.

Légidis, M. B. R., & Mascuñano, J. P. (2010) considered the situation of the automobile sector in Spain and its importance in the national economy. After their investigation, they obtained several results. The weight of the automobile sector in Spain makes a very important contribution to the GDP and provides a large number of job positions, both direct and indirect. The authors made an econometric estimate with which they calculated that a 1.2% drop in production would leave 143,000 people without a job. The main element to maintain domestic production are exports, primarily with European neighboring countries (of the European continent??)

Josep Bañuls and Raúl Lorente (2010) analyzed the type of automobile industry in Spain and what its transformation has been in recent years. Once the study was conducted, the authors came to the conclusion that the production of vehicles in Spain belongs to the low range, where usually the final sale price is a determining factor. Additionally, they found evidence that, since the 1970s, one of the most important factors in the Spanish industry lies in a cheap and low-conflict labor force, which allows this commerce to be more competitive with the rest of the countries.

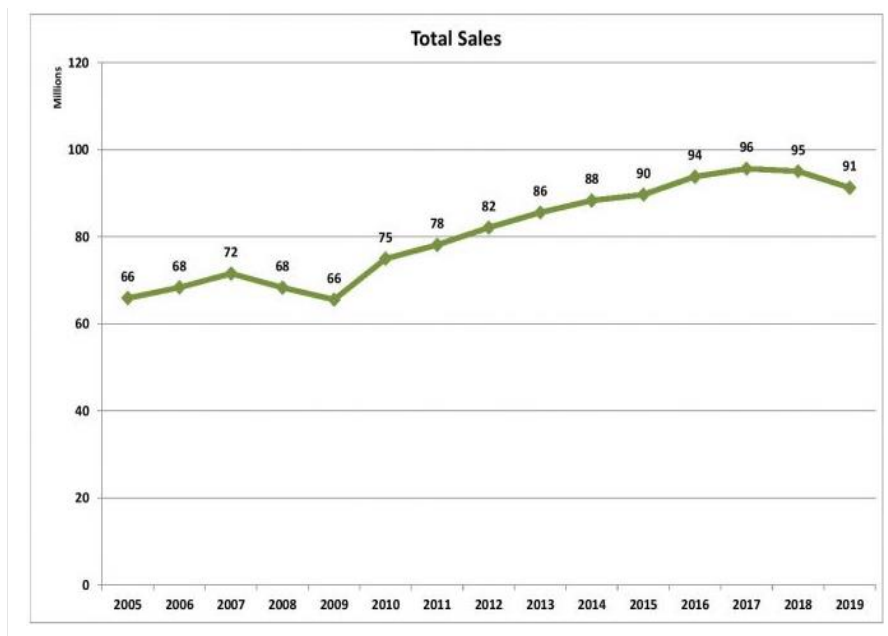


### 3. Description of the Market

The automotive sector is a market with a large volume of sales worldwide and prices, although diverse, are relatively high.

As it can be observed in the following graph, world car sales, both private and commercial, have been increasing since 2009. However, we can see how the growth in sales has stopped since 2016, and they are even being decreased since 2018. The year 2020 is not included in the following graph, since there is still not enough data. Nevertheless, it can be predicted that due to the health crisis this reduction in sales would have been even more evident.

*Graph 1. World Car Sales. 2005-2019. Millions of \$*



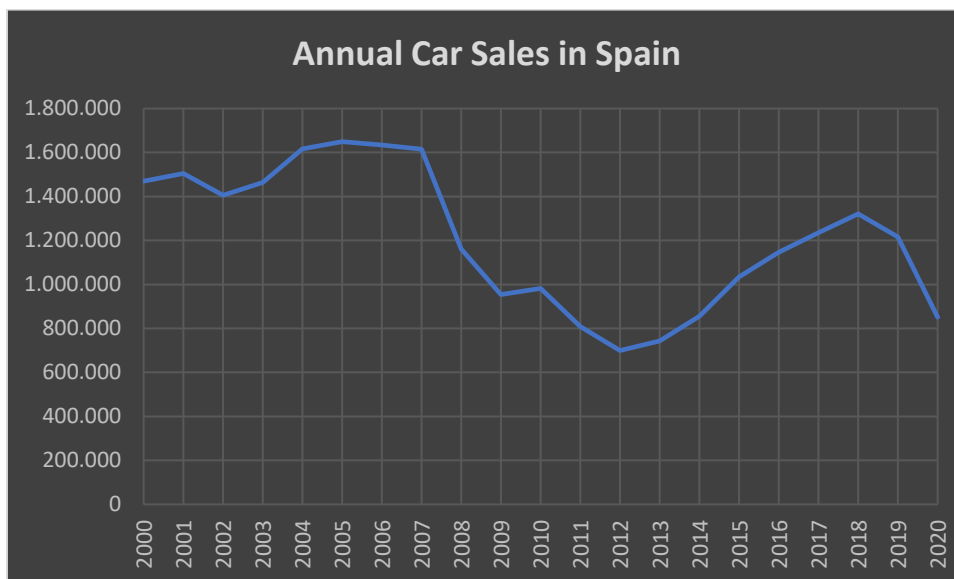
*Source: OICA*

In order to understand the sector and the causes that may have caused this effect on sales, we will proceed to conduct a study of the automobile market.

First, the unique characteristics of the automobile market are going to be analyzed. We will also deal with the purely technical aspects of the market together with the role that Spain plays in the industry. Subsequently, we will refer to the commercial relationships within this sector and, finally, we will comment on current events that are taking place in the automotive world.

In Spain, the evolution of sales is similar to the global trend, although with certain differences. First of all, we can observe that in Spain there was a massive purchase of automobiles that would, eventually, suffer the impact of the economic crisis of 2008, causing a turning point in the Spanish automotive sector. Even though there was a small rebound in 2010, it was not until 2012 that the industry would start improving after reaching its all-time minimum of the century. A constant and sustained growth in sales is observed until 2018 when passenger car sales decrease again. In the following graph the evolution of passenger car sales in Spain can be visually perceived:

*Graph 2. Annual Car sales in Spain. 2000-2020. Units*



Source: datasmacro

### **3.1 Technical Aspects**

The automotive sector has a high degree of competition, which can lead to a price war on the part of car companies. This fact could be one of the reasons why there are so many mergers or takeovers from one company to another. This usually entails a greater difficulty when entering to compete. Furthermore, it is characterized by the presence of scale economies. This enables much cheaper production when it is high, since, in order to compete in this market, a high investment is required to enter and remain.

It is highly important to mention that the automobile sector is extremely delocalized, although there are certain exceptions. The vast majority of the vehicles that are produced are not employed in the same country, but they are exported to another one. Countries

like Spain, Japan, Germany, France, England, for instance, produce a large number of vehicles to be exported. As it has been mentioned previously, there are countries in which practically all the vehicle production is for the same country, as in the case of China.

The key to the growth of automobile manufacturing has been the reduction of its costs, making the price more attractive to the consumer and thus, managing to increase its sales. In fact, the merit goes to the modular platforms. Through these platforms, companies from the same group can manufacture different models in terms of design and specifications in the same factory, which drastically reduces production costs. If there was a factory for each car model, the costs would be unaffordable. For example, in the Volkswagen group one of the modular platforms that are used is the so-called MQB with which it can manufacture up to 23 different models of 4 car companies: Seat, Volkswagen, Škoda and Audi.

The automotive industry is one of the driving forces behind the Spanish economy. In our country this sector generates around 10% of the GDP and employs almost 9% of the active population. Likewise, Spain is among the eight largest automobile producers in the world, with a total of 2.3 million vehicles, although since 2016 it has experienced a reduction in its production, mainly in passenger vehicles.

### **3.2 Commercial Aspects**

The particular case of China and its production outside its territory is due to four factors. The first is that it has no necessity to compete outside its borders as it is the world's largest automobile producer and its market is attractive enough to continue prospering and therefore, it has no need to search for new markets at the moment.

The second factor is the quality standards. Asian consumers do not have the same quality standards as the ones in the European or North American markets. In general, current Chinese cars have highly improbable finishes and their safety test results are very different from European cars, turning out to be generally less safe.

The third factor is emissions. Overall, Chinese combustion cars would not pass the European pollution requirements since they exceed the maximum allowed. This leads us to believe that if the Asian country decided to expand the automotive sector, it would do so with the electric car as long as it considers it interesting to expand to more markets and improve its quality standards.

The fourth and final factor is whether the country would have governmental impediments to do so. As it is already known, Europe is not usually characterized by imposing tariffs on third countries, but what about the United States? There have been a few years in which the trade war between China and the United States has ended up even censoring certain companies, in addition to tariff increases. Seeing this trend, it seems logical to think that the North American country could have imposed restrictions on the sale of Chinese vehicles in its territory in order to protect its own automotive industry.

Traditionally, the bulk of automobile exports have been in Europe and the United States, although countries such as Japan or South Korea have also played a very important role in exports. China is the world's largest vehicle producer, however since it only exports 3% of its production, it will not be considered as relevant.

Right now, the industry is at a turning point where emerging countries are beginning to change the sector. Mainly, it is the Southeast Asian countries that, gradually, are gaining ground in this sector and are presenting a threatening growth trend for the already established companies.

Countries such as Thailand, Indonesia, Vietnam, Brazil or Morocco are some of the examples in which vehicle production is increasing. Added to this, it should be also considered the potential that India is having lately, which, in fact, will be analyzed in the next point in depth.

For what concerns Spain, it is part of the European economic community, ergo, it has various trade agreements with multiple countries. First of all, Spain has a free trade agreement with all European countries, including Great Britain even after its recent departure. Currently, Spain also has trade agreements with the Mercosur countries, i.e. Canada and Japan, in addition to other trade agreements that are still in process. Finally, a bilateral agreement with China was recently agreed, although the automotive sector is not included in the agreement.

### **3.3 Most recent situation**

Large automotive groups tend to resort to the distribution of specific markets, since having such a large group of companies, it would be inefficient for them to compete with each other, in addition to the direct rival companies. To give an example, a few months ago the Renault-Nissan-Mitsubishi alliance had to restructure the company's entire

competitive plan and agreed to distribute the different markets. The French company Renault would continue to compete in Europe, Russia, South America and Africa. On the other hand, the Japanese company Nissan would focus on the United States, Japan and the surrounding areas. Finally, in the case of the Mitsubishi company, it would focus on Southeast Asia and Oceania.

This is a sector in which technological innovations help the industry grow by leaps and bounds, besides allowing both this industry and the rest to continue evolving. It has been several years in which car sales increased worldwide, but throughout 2020 this sector has also been severely affected by the pandemic, having mainly an impact on Europe. China is the exception and has even managed to increase car sales by 1% compared to 2019. In spite of everything, a growth in car sales is expected in 2021, which will exceed those during the previous year.

Traditionally, the automobile has been characterized by its propulsion by combustion engines thanks to oil. Given the fact that this natural resource tends to disappear in a few years, because it is extremely harmful to the environment and living beings, it has been years in which technological research has sought a variety of alternatives for mobility. There is currently a great boom in electric vehicles, which do not emit gases in their operation but they do during their manufacture. Therefore, it is expected that, both in the short term and in the long term, the automobile market will be flooded with this type of vehicle.

Every engineer's greatest dream has been to create a car powered by a hydrogen fuel cell. This project is even more ambitious because it allows solving the deficiencies of the electric vehicle such as autonomy and charging times. The main obstacle this technology has had, however, is the lack of investment by large corporations. This is due to the low consumer demand for this type of vehicle because of the high production costs that are involved.

Nevertheless, these are the same problems that the electric car encountered at the time and that currently it is highly evolved and it is gradually being able to reduce production costs. For this reason, it is expected that in a few years the price will be similar to the current combustion engine.

The main cause of high prices regarding the electric car is the cost of batteries, which accounts for 50% of the cost of production. Once the price of lithium is reduced, the price of the electric vehicle will decrease. The demand for lithium is increasing more and more and in contrast, its supply is insufficient. Nonetheless, there is evidence that the existence of lithium in the world is very abundant and that is why it is a matter of

improving the extraction of this element. It is also important to mention that there are viable candidates such as Zinc to replace Lithium. Consequently, we can safely expect that the price of electric cars will decrease, which will cause an increase in the production and export of these vehicles.

The development of alternative propulsion engines cannot only serve to increase the sale of land vehicles, but it can also contribute to further expanding globalization. Research is already being carried out on implementing electricity or the hydrogen fuel cell, both in maritime and air transport. If these two means of transport could be able to function with the proposed energy alternatives, the transport costs would be much lower than the current ones, making it marginal for international trade. It would provide the capacity for companies to lower their prices and increase their sales or their profits. Its application for road transport by trucks would be exactly the same: lower cost of transport that would benefit globalization. For this reality, it will be necessary to wait more years, since these are projects that are in an initial phase and they entail very high research costs.

Another important aspect of the market is the ownership model.

In the 1980s, the acquisition of a vehicle was common, because it gave its owners freedom of movement. Unless we are talking about cities like Hong Kong, where the use of private cars is less frequent — especially because they are more prone to the use of public transport or bicycles —, in the rest of the world it has been normal for both individuals and companies to own a vehicle in order to be able to circulate. Nowadays, this way of thinking is changing. People are finding it more interesting to rent a car in the medium or long term thanks to the “Leasing” or “Renting” models. It consists of renting a car for a certain number of years and once the time has elapsed you can either buy it or change it. This model is very useful mainly for companies because they only pay a fixed amount of money per month and they do not have to worry about any additional expenses, since everything would be included in this fee. By 2020 in Spain, 20% of the new registered vehicles belonged to one of these rental contracts.

### 3.4 Evolution of business mergers

As it has already been mentioned in previous points, the companies are entering a clear tendency to merge or to make acquisitions with one another. There are several reasons why these multinationals are tempted to follow this type of action.

The most important reason of all is competition. It is a market in which a huge number of large companies compete, and if they decide to group together to form a much larger corporation, they have fewer adversaries. Furthermore, they also achieve a more efficient production structure with lower costs. This creates higher profit margins and the ability to have a greater power over price control.

It should also be noted that the very characteristics of the market even force companies to do so. The market is under constant pressure from synergies linked to technology such as security systems, the environment, quality improvements or technologies among many others. Therefore, companies need large projects to achieve these requirements and if they do not merge, they would probably not be able to fulfill them.

Next, we are going to talk about some of the great automotive groups in the world. To do this, we are going to start with the heart of the automobile: Germany

In the German country there are three major automobile groups that coexist: Volkswagen, BMW and Daimler.

Volkswagen is the group that produces the most vehicles in the world, with a figure of almost 10.5 million cars in one year (2019). This group includes the following companies: Seat, Audi, Cupra (a sports car brand created by Seat), Škoda, Porsche, Bentley, Bugatti, Lamborghini and, of course, Volkswagen.

As it has been commented before, we also have the BMW Group that manages the BMW, Mini and Rolls-Royce brands and that altogether sell 2 million cars. Further to this, it is important to mention that in both German conglomerates, most of the shareholding belongs to two families: the Porsche family and the Quandt family, respectively.

To conclude with German companies, we have Daimler. Although this name might probably not sound that familiar at first, Mercedes does. Daimler is the group that includes Mercedes and Smart, but it also owns different commercial vehicle entities such as Fuso, Freightliner, BharatBenz and Setra, among others. Daimler has sold 2.6 million vehicles in 2019 and its shareholding is quite divided, although the largest percentage belongs to a Chinese businessman who also owns Volvo.

Hereafter we move to France, headquarter of two large automobile groups. On the one hand, we have the group resulting from the Renault-Nissan-Mitsubishi alliance. The alliance commercializes the brands Dacia, Samsung (only the automotive division), Lada, Alpin, Infiniti, Datsun and Venucia. Together, they sold almost 9.5 million cars (9.22 million). This alliance is the only one that cannot be categorized as an absorption but rather as a reciprocal share purchase. The alliance companies are highly diversified, being Daimler the company with the most shareholding power.

On the other hand, in France there is the recently merged Stellantis group, composed of the following companies: Peugeot, Citroën, DS, Opel, Vauxhall, Fiat and Chrysler. Since this merger has been completed very recently, there is no updated data, but if we take into account the sales they had in 2019 with a total of 3.18 million and FCA sales, which were 4.36 million, we have a total of 7.54 million units that have been sold.

We move from the center of Europe to the greatest Japanese power. Toyota represents the third group with a great number of sales, specifically 9.7 million. Lexus and Toyota itself are part of this group, although some truck and commercial vehicle companies are also included.

There are, in fact, many more business groups that exist in the world. Nonetheless, the main objective of this work is not to cover all of them, but simply to give an overview about the most prominent ones so that the reader can get a general idea of the magnitude of mergers in this industry.

Down below, a summary of various business mergers and sales during 2019 can be clearly observed in the following image. It is crucial to mention that the merger between PSA and FCA does not appear because it is very recent.

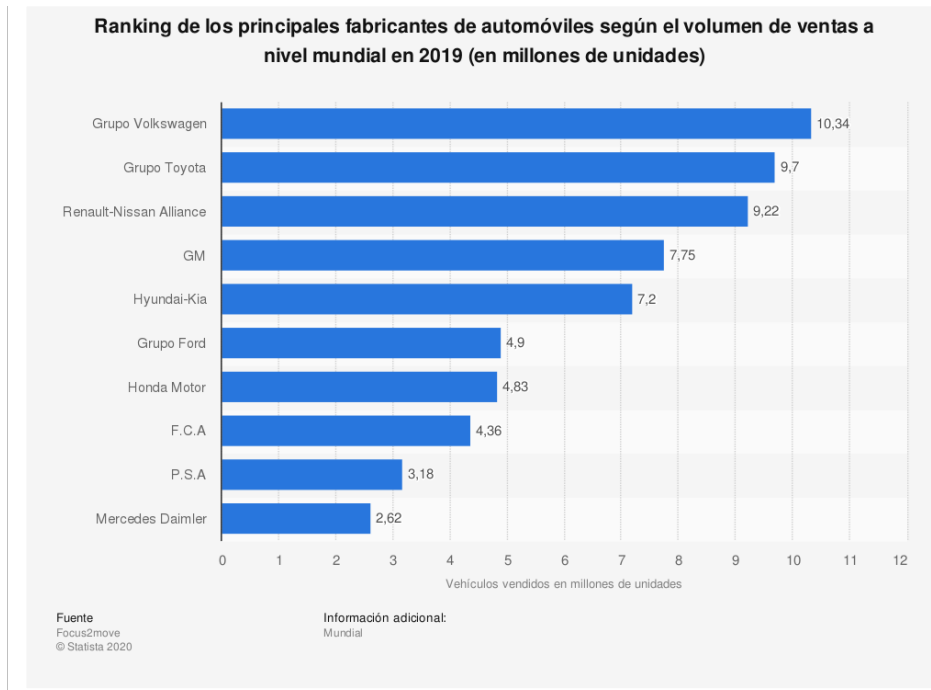


Graph 3. Most important automobile conglomerates



Source: dailyinfographic

Graph 4. Sales by manufacturer group in 2019. Million \$



Source: Statist

## **4. Descriptive Analysis**

In this new section, we will proceed to contrast and comment on the statements made in the previous points through and by using real data.

First of all, we will know the shares of the companies with the greatest presence in Europe and we will see through the concentration indices if this market is very concentrated or, on the contrary, the level of competition is very dispersed.

After that, we will analyze the automobile production and export figures in several countries. The focus will be on the analysis of both the developed and still developing countries. We will pause to comment on certain trends that are observed in some regions and what can be expected in the near future.

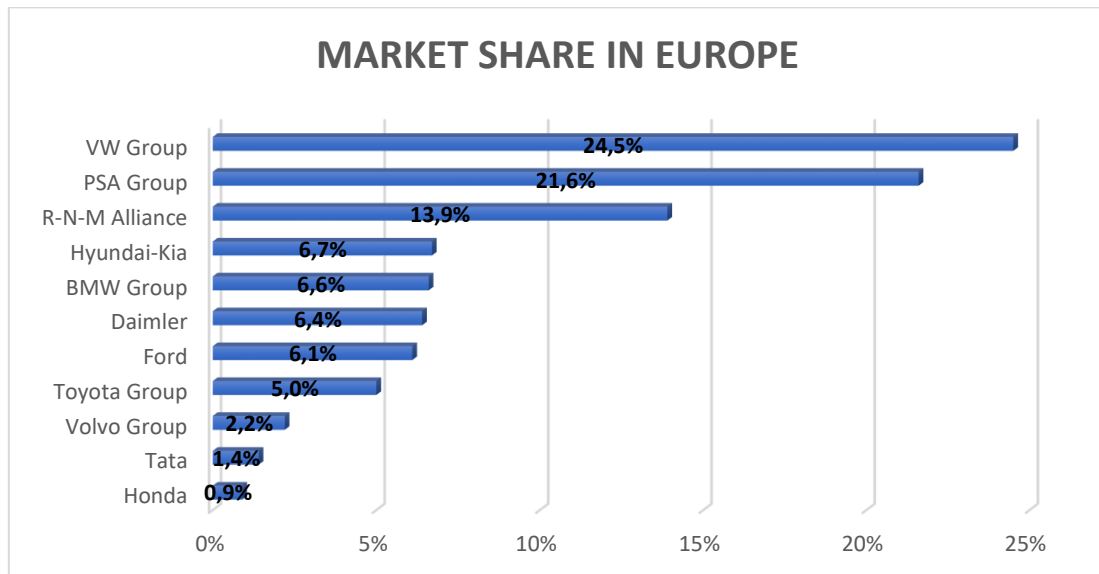
Finally, we will pay closer attention to how vehicle production has evolved in recent years in different countries, mainly those in which production is higher. Moreover, we will see how the pandemic caused by COVID-19 has indeed had a significant impact on global sales.

### **4.1. Concentration Indices**

As previously mentioned, a vast number of brands coexist in the automobile market, some focused on a very small and specific audience, and other so-called generalists that seek to attract the attention of the average consumer. However, in recent decades we have seen how the different entities have merged with each other for different purposes: to increase their market power, achieve cost savings, increase production, to improve the brand image, and many other reasons.

In the graph below we can see the market share of the 11 companies with the most market power in Europe.

Graph 5. Market Share in Europe. Percentage



Source: Statista

Through this bar graph we can see how the 11 most representative brands in Europe jointly represent 95.30% of the European market. If we analyze the market shares of the three most representative conglomerates more closely, we will see that between them they account for a total of 60% of car sales, a fairly high value.

Going down a few levels, we see that the rest of the business groups are more even in numbers with the exception of Honda and Tata. For its part, Volvo is in a growth phase, thus it is expected to increase its future sales.

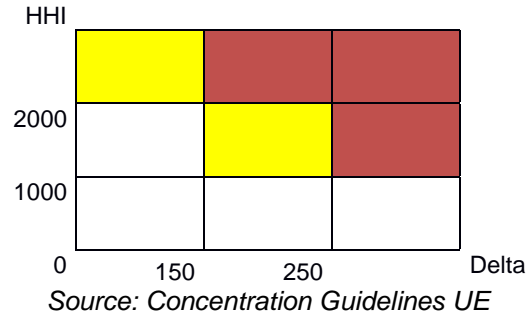
The European Union makes use of, among other mechanisms, the Herfindahl index to determine the market concentration and whether restrictions should be imposed once the companies are able to merge. In order to calculate this index, we simply have to square the market shares of the companies and sum all of them together.

$$HHI = \sum s_i^2$$

When analyzing the Herfindahl index, it is helpful to perceive a table that indicates in yellow the situations in which the European Commission can intervene when it comes to mergers and in red when it definitely does interfere. The delta value simply indicates the result of the new market share resulting from the companies that would like to merge and which is obtained as follows:

$$Delta = 2 * s_1 * s_2$$

Graph 6. *Herfindahl index*



A value of almost 1500 points has been obtained (HHI = 1500). The EU considers that a value between 1000 and 2000 means that the market is facing a moderate concentration. It does not present dangerous values, but it is worth taking into account, because if this trend continues, the market would move further away from the perfect competition model and would approach the oligopoly or even the monopoly.

It is worth highlighting that this index omits much relevant information from the market, such as the competition in each segment. For example, a company may be the only one offering a specific type of vehicle and therefore, it would have no competition.

In order to exemplify a possible case of mergers, in the present day the European Commission would not allow the Volkswagen Group to merge with any company with a share greater than 5% such as Toyota, since they would generate a delta value of 250, and thus they could not merge.

#### **4.2. Production and Exports sorted by country**

Previously in this work it has been discussed that the automotive industry is generally heavily delocalized. Although all countries consume a certain type of vehicle, it is common for it to be produced in a foreign country. To explain this statement with an example, we will begin by studying the case of Spain.

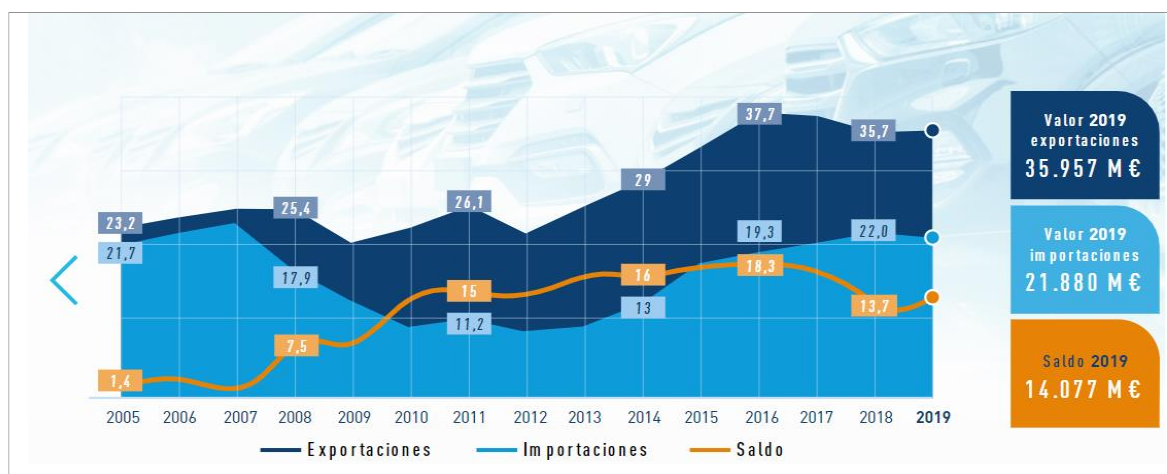
In Spain, a total of 2,822,632 vehicles were produced throughout 2019, including passenger cars, commercial and industrial vehicles. Among these three types of vehicles, the most representative type is that of passenger cars, since 2,209,769 vehicles were produced.

Regarding the exports, there were 2,310,070 units in total, of which 1,867,477 units were passenger cars. This implies that almost 82% of the vehicles produced in Spain were consumed in other countries. Nevertheless, this fact does not mean that the cars are not consumed in our country; imports also play a very important role.

In Spain we import fewer vehicles than we sell abroad, given the fact that vehicle exports are much higher than imports. Spain, thus, manages to obtain a commercial surplus in the automobile sector.

In the following graph, we can see the value of these imports and exports that provided a surplus of 14,077 million euros in 2019.

**Graph 7. Spanish Automobile Trade Balance. Million €**



Source: ANFAC

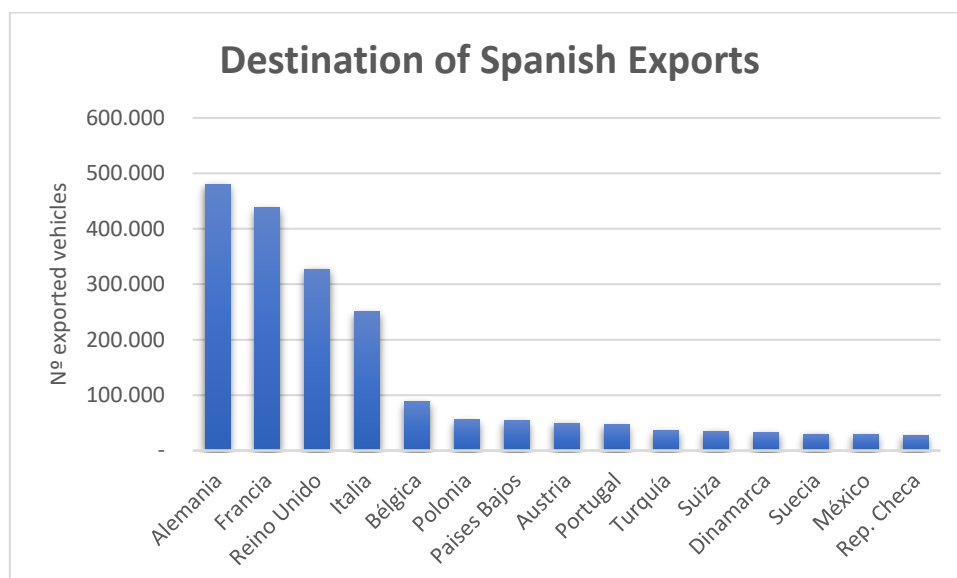
If we analyze the destination of these exports, we will see how the main market is Europe, with a 92.8% share. The rest of the continents present a very insignificant participation. The American continent is the second with the highest share of 3.4%.

Within the European continent, the countries that import the most Spanish vehicles are Germany, France, the United Kingdom and Italy respectively. Only these 4 countries acquire 64.7% of Spanish car exports.

Outside Europe, only Mexico is among the 15 largest importers of vehicles produced in Spain.

Thanks to the following table we can see the destinations of these exports depending on the volume of purchase.

Graph 8. *Destination of Spanish Exports*



Source: STATISTA

As we have seen in the case of Spain, the same happens with the vast majority of producing countries, although each one presents a different amount of production.

In the case of Japan, the third largest vehicle producer in the world (although the second if we only take into account passenger cars), it produced a total of 9.7 million units in 2019. Thanks to exports, the Japanese country obtained a value of 98 billion dollars. This implies that this country exports 12.9% of the world's vehicles.

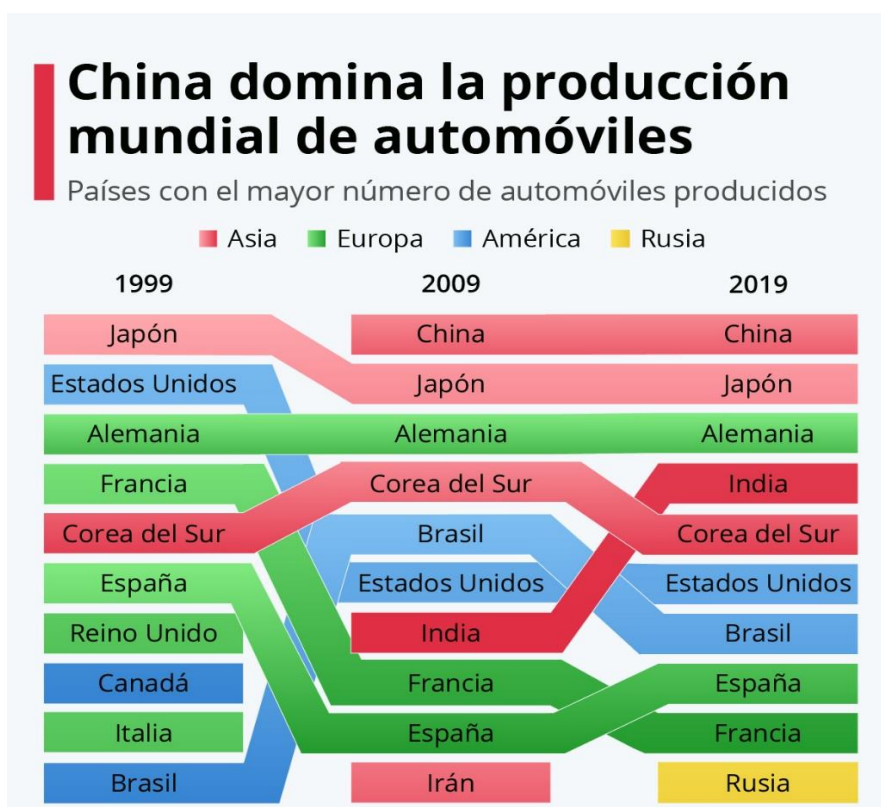
The United States is the second largest vehicle producer, which manufactures primarily commercial vehicles, and it has produced a total of 10.5 million vehicles. From the exports of the vehicles produced, the country obtained in 2019 a value of 56.2 billion dollars.

Although it is true that it is a very high number, it is also quite curious that the second largest vehicle producer in the world generates 40% less than Japan. This is because with the latest economic policies, in addition to their most protectionist tradition in the automobile sector, the sale of American vehicles is usually acquired within the country, whereas Japanese production is highly focused abroad.

For what concerns Germany, which is the fourth largest producer of vehicles, it produced a total of 4.7 million units in 2017, and exported 3.5 million units. Therefore, this means that the country exports almost 75% of its production. What is more, it is the country with the highest value for automobile exports in the world, with around 142 billion dollars. This is possible thanks to its large production volume, but also and above all it is thanks to the value that each vehicle presents individually, since high-end and luxury cars are usually manufactured with a higher selling price.

In this graph it can be observed how the production of passenger cars has varied in the world over the last 20 years depending on the country. We will see that the countries that are specialized in this sector continue to maintain their presence with relative solvency. In addition to this, there is a tendency towards the future with respect to emerging countries. We see how China, India and Brazil, among others, have been gaining ground and competing with the already developed countries.

Graph 9. Top 10 Automobile Production Countries. 1999, 2009, 2019



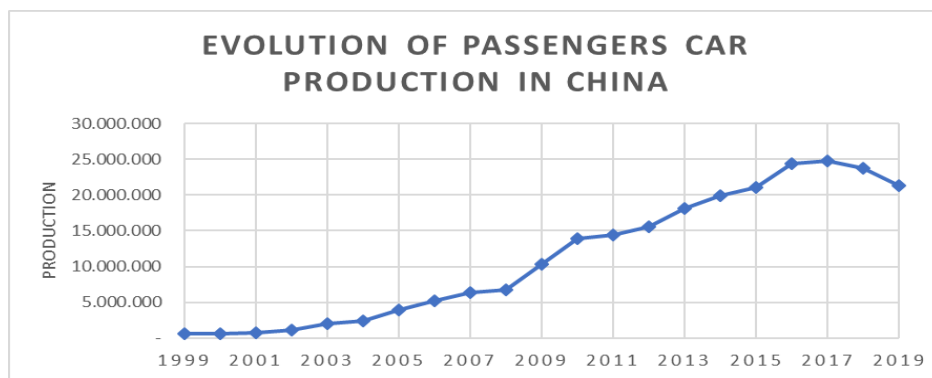
Source: Statista

### 4.2.1 China

China has become the world's largest producer of all kinds of products and, with regard to the automobile, it is not far behind. Currently, the People's Republic of China is the world's largest automobile producer. According to the International Organization of Automobile Manufacturers (OICA), a total of 21.4 million passenger vehicles were produced in China. If we include commercial vehicles, the total value increases to 23.4 million.

In the following graph we can observe the evolution of the Chinese automobile production in the last 20 years:

*Graph 10. Evolution of passenger's car production in China.*



Source: datasmacro

In order to have an idea of how gigantic this figure is, its neighboring country Japan produced 8.3 million passenger vehicles in the same year. The most paradoxical thing is that 20 years ago, China did not even appear in the rankings of the 10 largest producers in the world and since 2009 it has been leading the ranking of producers. This is due to the high population density of the country and the internal growth of the market.

As it has been mentioned earlier, the Chinese market is so large that it is capable of operating without the need to expand abroad thanks to the country's population of around 1,400 million registered inhabitants. In order to understand the magnitude of this number, there are 47 million people living in Spain.

If we take a look at graph 5, it can be clearly perceived that since 2017 the production of cars has decreased significantly, there are almost 3.5 million fewer vehicles from 2017 to 2019. This is even more than what Spain produces in a one single year (2,3 million in 2019).



The main factors are the trade war with the United States, which will be discussed later, and the pandemic crisis. This may be the main reason for China to be tempted to expand outside its territory. In addition, the Chinese market is beginning to show signs of maturity, which encourages further exports to third countries.

#### **4.2.2 Emerging countries**

Czech Republic, Morocco, Vietnam, India, Thailand, Brazil or Turkey among others, are all countries that have a point in common. They have the potential to be the world's next largest vehicle producers, or at least to host a significant portion of the automobile trade.

Countries such as India, Brazil or the Czech Republic are already sneaking into the world's largest vehicle producers. With respect to the first two, for some years now they have presented a great amount of production fairly comparable to those of the large countries and with a growing tendency, mainly India as a result of its very high population.

China started exactly in the same way that the Indian economy is currently progressing, taking advantage of a massive population and low production costs. This allowed the country to have a powerful domestic market with almost no need to export. However, India is not exactly following the steps of China since, on the contrary to them, they dedicate a significant part of their production to the export of vehicles.

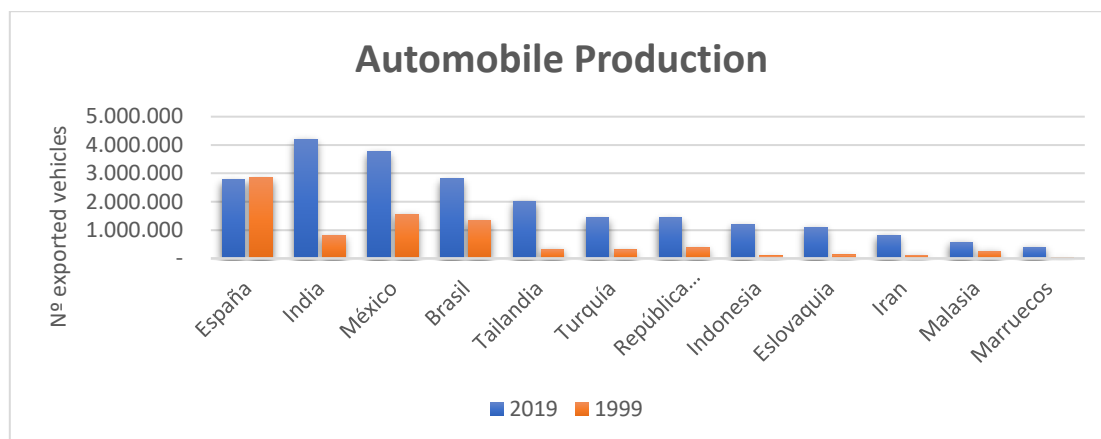
In the case of the Czech Republic, it has started to experience this growth relatively recently, thanks to its central European location and low production costs. That is why many European factories are closing their doors in order to move to that country, in addition to being the favorite destination for the development of new technologies for electric vehicles.

To express the evolution in the production of these countries, the number of vehicles that were produced in 1998 and those that were produced in 2019 has been collected. The production of Spain has also been included in order to observe how its growth has developed, since we need to keep in mind that our country is one of the largest producers worldwide.

By observing the graph, we can see that Spain presents approximately the same production as 20 years ago. However, all emerging countries with potential for the automobile sector have significantly increased their production in the same period of time.

On the one hand, India and Mexico have not only increased, but they have far exceeded the Spanish production. On the other hand, Brazil, Thailand, Turkey, the Czech Republic and Indonesia have shown significant growth in the last 20 years, although less.

Graph 11. **Automobile Production by country. 1999, 2019**



Source: datosmacro

Considering the real growth that emerging countries have experienced in recent years, it remains to be seen what potential they have in order to continue growing more than they have already done.

Probably the country with the most potential is India, as it is already showing in other sectors by having a very high population, being the second most populated country in the world and very close to China. It also has a very cheap labor force and a market that has not yet matured, that is why there is a clear opportunity for growth.

The cases of Mexico and Brazil are very similar, since both are in a relatively similar political and economic situation, in addition to the fact that they are specializing in the automotive sector. Unlike India, these two countries depend, to a greater extent, on exports since their citizens are not the target audience, or at least not currently. However, once they manage to improve their living conditions, they would become markets with a great potential.

As for the countries located in central and eastern Europe, as it has already been commented, their factories are already increasing and if they maintain the current conditions for multinationals, it is only a matter of time before the number of factories in these regions increases. In the same way, Morocco has enormous potential thanks to its proximity to Europe and its low production costs and it may in the future be a direct and main opponent to the Spanish production.

### 4.3 Current global car sales

For a few years now, automobile production has dropped substantially in the vast majority of countries in the world for several reasons.

These drops can be attributed to the confrontations between the US and China, which have caused damage to the rest of the countries, although we will see this in more depth in the following section.

It can also be thought that it is because of the maturity of the markets since they do not need as many vehicles as they used to. As we discussed previously, the change in mentality when it comes to acquiring a vehicle or simply being able to afford it can be another relevant factor.

Whatever the most significant reason is, the fact is that production is slowing down. It is not only about the year 2019, but it is a trend that can be seen throughout several years. The following table shows the production by country in recent years together with the percentage variation that has existed.

*Table 1. Vehicle production sorted by country. 2016 - 2019. Unites and Variations*

Country	2016	2017	2018	2019	Var. 2016-2019
Spain	2.885.922	2.848.335	2.764.067	2.772.523	-3,93%
Germany	6.062.562	5.645.581	5.120.409	4.661.328	-23,11%
Great Britain	1.816.622	1.749.385	1.583.490	1.360.577	-25,10%
France	2.082.000	2.227.000	2.269.000	2.202.460	5,79%
Italy	1.103.516	1.142.210	995.807	854.384	-22,58%
USA	12.198.137	11.189.985	10.986.225	10.533.653	-13,65%
Japan	9.204.590	9.693.746	9.201.291	9.168.651	-0,39%
China	28.118.794	29.015.434	25.705.558	23.362.477	-16,92%
Canada	2.370.271	2.199.789	1.999.929	1.893.274	-20,12%
India	4.488.965	4.782.896	4.727.967	4.194.763	-6,55%
South Korea	4.228.509	4.114.913	4.028.834	3.950.617	-6,57%
Mexico	3.597.462	4.068.415	3.908.139	3.772.861	4,88%

Source: *datosmacro.com*

The table includes the 12 largest vehicle producers in the world. In this table we can observe a clear decrease in the production of the most representative countries of the automotive industry.

There are some exceptions in which there has been no decrease. On the contrary, production has increased, although this is not the general tendency that is usually perceived. It is also true that there are countries that are not listed in the table and have increased automobile production, but these are much smaller markets.

#### **4.3.1 The impact of COVID-19**

As it is already known, these last few years have been very difficult for everyone and the automotive sector is not the exception.

There are two main reasons why the year 2020 has not been taken into account in this work. On the one hand, the first and main cause is that it is still too early for there to be concrete data on the market. On the other hand, the second reason is that COVID-19 has negatively impacted global production.

Since the beginning of 2020, the global demand for cars has decreased so much that there were no precedents in history. Given the restriction of mobility that occurred for several months around the world, there was obviously no demand for cars. Potential customers did not need them nor could they use them, and the dealerships remained closed.

Subsequently, when the mobility restrictions were more permissive, the economic situation of the population was seriously affected, so they could not afford to buy a new vehicle. In fact, the second-hand market was flooded with new vehicle offerings. This affirms that the need of acquiring a vehicle had decreased considerably compared to previous years.

This highly uncertain situation makes the production and sales results of the automobile sector very unfavorable. It should be noted that this situation is exceptional and it would not be convenient to confuse it with the negative trend that comes from previous years. In other words, although the data indicate that the tendency in car sales is decreasing, the COVID-19 situation should not be associated with it but should be treated as an independent effect.

## **5. Trade Policy**

Trade policies have served for many years to achieve better relations between countries and reduce their tariff rates, among other functions. However, these last few years have been very atypical, and with important confrontations. Luckily, they have not ended up leading to great repercussions, but they could have started very serious consequences.

Firstly, the dispute between Great Britain and Europe over the famous "Brexit" began and shortly after a trade war started between the two largest powers in the world: the United States and China.

Nevertheless, not everything has been political confrontations, but there have also been years of new commercial relations that end up favoring international trade. The majority of these new relationships are promoted by the European Union and its perception of a world open to free trade.

For the automotive sector — one of the most important —, these changes in commercial relationships may have great repercussions, both positively and negatively.

### **5.1 New Business Relations**

Presumably, the largest trade agreement that has taken place in the last five years has been between the European Union and Japan, which agreed to a total reduction in tariffs. To quantify the import of this agreement, if we add the GDP of both regions, it will represent a third of the global GDP.

This is extraordinary news for the automotive industry, mainly for the Japanese multinationals Toyota, Nissan, Suzuki, Mazda and Honda. With the exception of Toyota, sales of Japanese brands in Europe are substantially lower than other manufacturers. With this free trade agreement, these companies have an excellent opportunity to compete on a more equal footing with their competitors.

On the other hand, there are the trade negotiations with Mexico and Mercosur, in the years 2018 and 2019 and in which they agreed to free trade in goods and services. Again, it is an excellent opportunity for the automotive sector. Mexico is one of the largest automobile manufacturers in the world. Even if its main automotive trading partner is the United States, the ability to trade with Europe duty-free can help the country grow even more.

For what concerns Mercosur, they are countries with potential for the development of automobiles, with Brazil being the most prominent one above all. These countries are destined for their automobile exports in the regions of the continent and certain countries in Southeast Asia. A free trade agreement with Europe is one more market in which they will be able to compete and grow.

## **5.2 China and the United States**

The term of the United States' President Donald Trump was a paradigm shift that affected both his country and the rest of the world. One of his objectives in reference to trade was the increase of protectionist measures.

In 2018, President Trump started a trade war with China, ensuring a 25% increase in tariffs on a myriad of products, including the import of cars. But the Asian giant did not want to succumb under any means. Therefore, they responded with equally strong measures.

The conflict continued for two years, although it was not constant. On several occasions, both countries lowered their tone, even reaching truces that lasted a short time, because afterwards tensions started to arise again.

The United States did not stop here and in 2020 announced tariff measures against the European Union, setting a tariff on the import of vehicles of 25%. For the European market it was a terrible shock, since a significant volume of production was destined to the North American country. Finally, a trade agreement was considered between the United States and China that would end the threat of a tariff increase, which could have been a bomb for multiple sectors, especially the automotive industry.

## **5.3 Brexit**

Within the European Union there was an internal struggle fueled by Great Britain with Europe. The British no longer wanted to belong to the European Union and during all this time, the European Union's intention was to achieve a calm and peaceful exit, so that, although the British country was no longer part of the European community, it would continue to trade freely between all the regions. It was not until a few days before the final departure that an agreement was reached between both parties.

For the automotive sector it would have certainly been a very serious problem. Along with Germany, Great Britain has a large number of foreign car factories. In addition,

exports to Great Britain from European countries are also significant and they generate an immense economic volume. The imposition of tariffs would have contracted the automotive sector. There could even have been a massive exit of companies, which would have left the rest of the countries in a situation of uncertainty.

Fortunately for the automobile industry, the situation ended in similar terms such as the trade war between the United States and China, as a one more historical event, but without any effect for the future.

## 6. Econometric Estimation

Through the econometric studies that I have been investigating, I have found interesting being able to make a simple econometric estimation that calculates how the registrations of passenger cars in Spain have been influenced in the last two decades.

For this, a multiple regression model has been completed, in which the annual motor vehicle registrations (MVR) in Spain, the GDP per capita (GDPpc), the consumer confidence index (CCI) and the automobile price index (API) are included and taken into consideration.

It is expected that from this estimate a significant and positive relationship in all the variables except in the car price index will be obtained, since a negative relationship is also supposed with the dependent variable.

The use of these variables will be carried out through a time series model, based on the data that have been extracted from the Eurostat database and the Ministry of Economic Affairs and Digital Transformation.

Therefore, the variables of the work are the following:

### **Dependent Variable:**

- Car registrations in Spain: Referred to the ratio between registrations and national population per thousand people in each year analyzed (2002-2020). Expressed in registrations per thousand people.

### **Independent Variables:**

- Car price index in Spain: Represents the variation in car prices based on the year 2016. Expressed on the basis of 2016.
- Consumer Confidence Index: Represents the confidence of the average consumer about the state of the national economy as well as their own. Expressed in percentage points (%).
- GDP per capita: Ratio between the national GDP and the number of inhabitants in each year analyzed. Expressed in euros (€).



The idea of this estimate stems from three econometric studies conducted by different authors in which each one tries to relate a variable to the number of passenger car registrations.

The first article was published by ANFAC (2010), where they complete multiple econometric estimates. One of them turned out to be the registration of passenger cars in Spain over a time series and which it was studied based on a series of variables. Although the independent variables were discarded due to their complexity when obtaining data, they actually helped to find others.

In Dargay's (2001) study an econometric estimation was made in which family income and car prices were related to their registrations. In order to analyze the income, the GDP per capita was used and the Automobile Price Index was employed for prices.

Finally, Beck (2003) again estimated registrations based on the consumer confidence index.

At the time of obtaining the data, some adjustments had to be made to adapt them adequately to the estimate.

For registrations, the data was sorted by months. Only the months corresponding to each year were added in order to transform the data to annual. Subsequently, to obtain a rate, it was divided by the population of each year and then it was multiplied by a thousand.

The variable of the Automobile Price Index was already at base 100 with respect to 2016, even though they were again displayed by months. Consequently, the months corresponding to each year were added.

As for the Consumer Confidence Index, the procedure was very similar to the previous one, although with one exception. The data were obtained by months, but this time they were not referenced to a base year, but rather they indicated a percentage. The percentages of every month that corresponds to each year were added and divided by 12, i.e. the months that compose a whole year.

the GDP per capita was obtained per year and no adjustment was necessary. It is true that the unit could have been transformed and went from euros to thousands of euros by dividing it by a thousand, but in the end this operation was not completed .

This information, as well as the set of variables and their source of extraction, can be summarized according to the following table

Table 2. **Data source and scope of the work**

Variables	Definition	Scope	Source of Data	Citation
Motor Vehicle Registration (MVR)	It collect the ratio of cars per thousand inhabitants	Country Level (Spain). Annual frequency for the period 2002-2020	<ul style="list-style-type: none"> <li>- Indicators and Macroeconomic Reports</li> <li>- Indicators of Production and National Demand.</li> <li>- Private consumption</li> </ul>	Ministry of Economic Affairs and Digital Transformation (Extracted on April 6, 2021). Retrieved from <a href="http://serviciosede.mineco.gob.es/Indeco/reports/verSerieGraf.aspx/?codigo=271200&amp;frec=-1">http://serviciosede.mineco.gob.es/Indeco/reports/verSerieGraf.aspx/?codigo=271200&amp;frec=-1</a>
Automobile Price Index (API)	It indicates the variation in prices based on the year 2016		<ul style="list-style-type: none"> <li>- Indicators and Macroeconomic Reports</li> <li>- Prices and costs</li> <li>- Consumer price index</li> </ul>	Ministry of Economic Affairs and Digital Transformation (Extracted on April 6, 2021). Retrieved from <a href="http://serviciosede.mineco.gob.es/Indeco/reports/verSerieGraf.aspx/?codigo=4000711&amp;frec=-1">http://serviciosede.mineco.gob.es/Indeco/reports/verSerieGraf.aspx/?codigo=4000711&amp;frec=-1</a>
Consumer Confidence Index (CCI)	Consumer confidence in net percentage		<ul style="list-style-type: none"> <li>- Indicators and Macroeconomic Reports</li> <li>- Opinion Polls</li> <li>- Consumer Survey</li> </ul>	Ministry of Economic Affairs and Digital Transformation (Extracted on April 6, 2021). Retrieved from <a href="http://serviciosede.mineco.gob.es/Indeco/reports/verSerieGraf.aspx/?codigo=330000&amp;frec=-1">http://serviciosede.mineco.gob.es/Indeco/reports/verSerieGraf.aspx/?codigo=330000&amp;frec=-1</a>
GDP per capita (GDPpc)	Real national GDP with respect to the population in euros		<ul style="list-style-type: none"> <li>- Eurostat</li> <li>- General and regional statistics</li> <li>- sdg_08_10</li> </ul>	Eurostat (Extracted on April 6, 2021). Retrieved from <a href="https://ec.europa.eu/eurostat/databrowser/view/sdg_08_10/default/table?lang=en">https://ec.europa.eu/eurostat/databrowser/view/sdg_08_10/default/table?lang=en</a>

## 6.1 Statistics

As a summary, in the following table we can observe the main statistics of the variables that have been included in the econometric model.

**Table 3. Main Statistics. Observations 2002-2020**

Variable	Average	Median	SD	Min.	Max.
MVR	27.2	26.5	8.08	15.2	38.9
API	95.7	94.8	5.05	88.4	105.
CCI	-15.3	-12.0	9.88	-33.7	-3.35
GDPpc	23105	23040	970	21460	24910

Source: Gretl

Regarding the table, it can be affirmed that the average number of motor vehicle registrations is 27.2 per 1000 citizens between the years 2002-2020 in Spain. In the same way, thanks to the table it can be inferred with the rest of the variables in the given period: the average of the car price index being 95.7 on base 100, the average of the consumer confidence index being -15.3% and the average GDP per capita 23.105 euros.

Regarding the standard deviation, it represents the average value of the variables that are far from the global mean value. In our case, the dependent variable Motor Vehicle Registration (MVR) is in a range around 8.7 far from the average. In turn, although the GDP per capita is numerically the largest standard deviation, when the coefficient of variation is calculated, it turns out to be the smallest. Therefore, the variable that suffers the most net variation is the consumer confidence index (CCI) .

Here below, we can see the result of our correlation matrix in which we will observe whether or not there is an affinity between our variables and in what proportion:

**Table 4. Correlation coefficients. Observations 2002-2020**

MVR	API	CCI	GDPpc	
1.0000	-0.0928	0.6589	-0.2476	MVR
	1.0000	0.2760	0.4969	API
		1.0000	-0.4131	CCI
			1.0000	GDPpc

Source: Gretl

As it can be perceived in this table, our explanatory variables do not present a significant correlation with each other. It is true that there is a certain correlation between GDP per capita and the automobile price index, specifically 0.4969, although it is not high enough to be alarming with respect to our estimate.

## 6.2 Econometric Model

To elaborate this study, it has been proceeded to specify the econometric model as follows:

$$MAT_t = \beta_0 + \beta_1 IPA_t + \beta_2 ICC_t + \beta_3 PIBpc_t + \beta_4 temp_t + \varepsilon_t$$

$$t = 2002, 2003, \dots, 2020$$

This is a level-level model, since we intend to analyze the impact of increases in one unit in the independent variables and which effect originates on the dependent variable (registered passenger cars), regardless of the regressors' level.

As observed in the equation, we want to determine how the car price index, the consumer confidence index and the GDP per capita (independent variables) influence the car rate (dependent variable) in Spain, through the data that is provided for the period that goes from 2002 to 2020.

Next, and as a visual summary, both the variables that will be used as regressors and the dependent variable are shown in a table.

Table 5. *Expected relationship between variables*

Dependent variable	Independent variable	Economic intuition
<b>Motor vehicle registrations (MVR)</b>	Automobile Price Index (API)	$\beta_1 < 0$ <b>Negative Expected Relationship</b> As car prices rise, passenger car registrations are expected to decrease
	Consumer Confidence Index (CCI)	$\beta_2 > 0$ <b>Positive Expected Relationship</b> If the consumer has greater confidence both in the economy as well as their personal economy, car registrations are expected to increase
	GDP per capita (GDPpc)	$\beta_3 > 0$ <b>Positive Expected Relationship</b> During the years in which the GDP per capita is higher, the number of registrations is expected to be higher as well
	Temporal tendency (temp)	$\beta_4 > 0$ <b>Positive Expected Relationship</b> Over the years, car registrations have increased

### 6.3 Estimate

In the previous section, the econometric model has been specified, so now we will proceed to estimate it based on different estimation methods using the GRETTL statistical program. To do this, we will estimate using Ordinary Least Squares (OLS) in order to try to observe if the variables are significant in the model and to what extent.

Once the database has been created and the variables included in the statistical software, we have obtained the following output:

*Table 6. OLS Model. Observations 2002-2020*

Dependent variable: MVR

	<i>Coefficient</i>	<i>Std Dev</i>	<i>Statistic t</i>	<i>P value</i>	
const	-85.4508	9.65705	-8.849	<0.0001	***
API	1.08511	0.0630227	17.22	<0.0001	***
CCI	0.516282	0.0329259	15.68	<0.0001	***
GDPpc	0.00148009	0.000303361	4.879	0.0002	***
time	-1.75983	0.0939739	-18.73	<0.0001	***
Average of Dep. Variable	27.15207	SD of dep. variable		8.083034	
Suma de cuad. residuos	38.40389	SD of regression		1.656241	
R-squared	0.967345	R-squared corrected		0.958015	
F(4, 14)	95.14223	P value (of F)		5.49e-10	
Log-likelihood	-33.64517	Akaike's Criterion		77.29034	
Schwarz Criterion	82.01254	Hannan-Quinn Criterion		78.08952	
SRCC	0.143987	Durbin-Watson		1.567051	

*Source: Gretl*

We have obtained a significance of the variables at all possible levels of significance. Before analyzing the results, we have studied whether all the necessary assumptions are met for the estimate to be valid.

By using the Breusch-Pagan test, we have obtained homoscedasticity at all levels of significance. In this contrast, we start by assuming as a null hypothesis the homoscedasticity of the sample and as an alternative hypothesis the presence of heteroscedasticity.

**Graph 12. Heterocedasticity Contrast. Observations 2002-2020**

Contraste de heterocedasticidad de Breusch-Pagan  
MCO, usando las observaciones 2002-2020 (T = 19)  
Variable dependiente: uhat^2 escalado

	Coefficiente	Desv. típica	Estadístico t	valor p
const	19.6267	13.5450	1.449	0.1694
IPA	-0.0969224	0.190682	-0.5083	0.6192
ICC	-0.0285718	0.0571219	-0.5002	0.6247
PIBpc	-0.000442972	0.000612156	-0.7236	0.4812
time	0.0451425	0.134660	0.3352	0.7424

Suma de cuadrados explicada = 7.99128

Estadístico de contraste: LM = 3.995638,  
con valor p = P(Chi-cuadrado(4) > 3.995638) = 0.406597

Source: Gretl

The possible existence of autocorrelation in the variables has also been analyzed and no problem has been detected at all levels of significance. We start from our null hypothesis which indicates that there is no autocorrelation between the applicative variables. Conversely, the alternative hypothesis indicates the existence of autocorrelation between the variables.

**Graph 13. Autocorrelation Contrast. Observation 2002-2020**

Contraste Breusch-Godfrey de autocorrelación de primer orden  
MCO, usando las observaciones 2002-2020 (T = 19)  
Variable dependiente: uhat

	Coefficiente	Desv. típica	Estadístico t	valor p
const	-0.255061	14.8005	-0.01723	0.9865
IPA	0.00560270	0.208505	0.02687	0.9790
ICC	-0.00752183	0.0638904	-0.1177	0.9081
PIBpc	-1.60292e-05	0.000669209	-0.02395	0.9813
time	-0.00277312	0.147156	-0.01884	0.9853
uhat_1	0.155676	0.285318	0.5456	0.5946

R-cuadrado = 0.022388

Estadístico de contraste: LMF = 0.297704,  
con valor p = P(F(1,13) > 0.297704) = 0.595

Source: Gretl

Since the estimate is valid, we can proceed with the analysis. As it has been mentioned previously, all the variables are significant in the model. Nevertheless, two of the variables have a different sign than expected.

It is logical to think that the higher the GDP per capita in a country is, the more willing its citizens will be to consume and, consequently, will buy more vehicles. The same applies

to the consumer confidence index. It is to be expected that, the more confident the consumers feel within their national economy, the more they will be willing to acquire a new vehicle.

On the other hand, the IPA variable with a positive sign indicates that registrations are increasing, even though the car price index is higher. A priori, this may not make much sense since it contradicts the economic intuition of supply and demand, but some research has been done. In recent years the average price of a new car in Spain is getting higher year after year. According to the tax agency, the average price of registered vehicles is the following:

*Table 7. Average price of cars per year in Spain*

<b>Year</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>
<b>Average Price</b>	<b>16.688€</b>	<b>17.000€</b>	<b>17.249€</b>	<b>18.061€</b>	<b>19.341€</b>

*Source: Tax Agency*

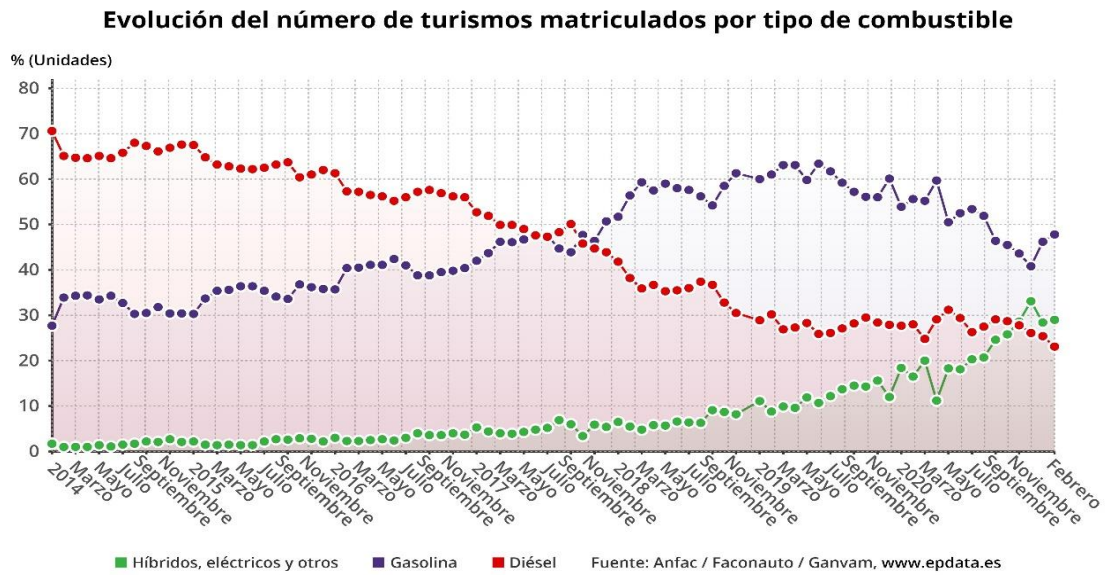
We can see a constant growth of the average price despite the fact that the number of registrations does not follow the same tendency. There are several explanations that could clarify this fact. Probably the quality standards of consumers are changing and they want to acquire vehicles with better benefits.

It is also most likely that, given the incentives to purchase electrified vehicles, more hybrid or electric vehicles have been acquired by consumers, being these types of cars more expensive.

Another possibility is that those who do not acquire vehicles have the lowest income. In this way, as there are fewer buyers that, at the same time, are the ones who acquire low-cost vehicles, the average price increases. The most extreme explanation to this situation is that there is probably the presence of a bubble in the automotive sector.

From the Data Agency (epdata), a detailed graph about the registrations in Spain has been obtained. It is observed that both gasoline and diesel cars have decreased substantially, especially those of diesel. However, the registrations of electrified passenger cars, whose price for the moment is higher than combustion, are increasing significantly.

Graph 14. Cars Registered by Fuel



Source: Epdata

On the other hand, we have the negative time trend. Registrations were expected to be higher than at the beginning of the century, but after this estimate we see that registrations, year after year, are lower. As already mentioned in previous sections, vehicle sales have been decreasing for a few years, especially if we compare it with the figures that are presented from the beginning of the century.

The econometric regression would be the following:

$$MAT_t = -85.451 + 1.085 * IPA_t + 0.516ICC_t + 0.0015 * PIBpc_t - 1.76temp_t + \varepsilon_t$$

$$t = 2002, 2003, \dots, 2020$$

The interpretation of the variables would be as follows:

API → An increase in the car price index by one unit compared to 2016 will increase the number of registered passenger cars by 1,085 per 1,000 people.

CCI → An improvement in the consumer confidence index by 1% will increase passenger car registration by 0.516 per 1,000 people.

GDPpc → An improvement in the GDP per capita in a thousand euros is estimated to cause an increase in passenger car registrations by 1.5 per 1,000 inhabitants.

Temp. → Each year, 1.76 registered passenger cars decrease per 1,000 inhabitants.



However, the estimate presents several weaknesses and limitations. The most important is that one of the variables contradicts the economic intuition that is expected despite having an explanation. It is a model focused exclusively on Spain and it could not be extrapolated to the rest of the countries, since each country presents different peculiarities.

There are also other factors that are very significant and that are not included in the model. For instance, the amount of the financial support and help for the purchase of vehicles by the government. A higher quantity could increase enrollments, keeping the rest of the variables constant (*ceteris paribus*).

For further investigations, and by taking into consideration a longer period of time and sufficient data, it would be interesting to study the behavior of registrations at a European level, distinguishing the propulsion engine used and thus, being able to quantify the differences between countries in the integration of electric vehicles.

## Conclusion

Throughout the carrying out of this project, I have analysed multiple aspects of international and national trade with respect to the automotive sector. Using the provided data, we could notice a global obvious decrease in car sales. This effect started to be seen in the year 2018 and got accentuated in 2020 due to the COVID-19 pandemic.

For Spain, automobile production is one of the most significant sector for its economy, and it has remained relatively constant over the last two decades. We also emphasize the fact that its main clients are European countries. It also exports to other countries, but to a quite lesser extent.

Another trend that we studied was the increase in automobile production in developing countries, mainly in Asia, being China and India the ones that stand out the most for its notable progress in influence in the sector.

We also studied the trend of the companies involved in the sector. We could appreciate a clear tendency towards mergers or acquisitions between companies, with the purpose to form large conglomerates. Some examples that we can mention are Volkswagen Group, Stellantis or the PSA Group. We also wanted to prove if the previously mentioned trend could become a problem for market competition. Although the obtained data does not indicate that the market is concentrated, it is actually within risk values when it comes to future mergers.

We dedicate a section to talk about the most recent situation regarding trade policies and which have been or could have been its effects on the world economy. The most relevant event was the trade war between China and the United States, as it could have severely affected this sector owing to collateral damage.

Using an econometric estimation, we conclude Motor vehicle registrations in Spain have gone down if we compare it with the beginning of the century. We obtained procyclical results among motor vehicle registrations with respect to the Consumer Confidence Index, the GDP per capita and the Automobile Price Index. The last one contradicted the economic intuition, but nevertheless, sufficient arguments were given to validate this statement.

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